A Comparison of the Auditory Perception of English Tense and Lax Vowels Between Native and Non-native Speakers

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Abstract. A large number of experiments have studied the perception and output of some English speech sounds of Chinese English learners, yet there are relatively few comparing the perception ability of native and non-native speakers to English speech sounds (taking vowels as an example). Therefore, this article compares the auditory perception of English corresponding tense and lax vowels between native and non-native speakers through an auditory experiment. By referring to relevant experiments and literature, the author also sums up the reasons for the contrast of auditory perception between native and non-native speakers, as well as the limitations and improvement methods of current English teaching in China. The results show that the ability of native English participants perceiving corresponding English vowels is much better than that of non-native English participants. Moreover, English majors' perception of corresponding English is higher than that of non-English majors, which indicates that systematic listening and pronunciation training (taking vowels as an example) is of great help to the perception of corresponding English vowels in the learning process of English majors; In addition, practicing more and forming the same or similar vowel phonemes as English native speakers on the basis of experiential perception are more feasible and accurate than the method of vowel identification by the length of tense and lax vowels that most Chinese English learners rely on.

Keywords: Vowel perception · Vowel differentiation · Vowel output · Tense and lax vowels · Length of the pronunciation · Auditory experiment

1 Introduction

In the process of communication, the difficulty of vowel perception will seriously affect people's understanding of the other's speech, leading to the misunderstanding of the meaning of words and resulting in poor communication. This may also bring about the auditory and pronunciation deviation. The human phonological system is dynamic and constantly evolving when learning another language. For adult second language learners, in the process of learning and producing second language, the learners will be continuously influenced by their mother tongue due to the continuous interaction between mother tongue and the second language sounds. The improvement of learners'

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second language proficiency will also enhance their ability to recognize and produce second language speech sounds (taking vowels as an example).

Most of the current experimental research in this field is about the acquisition of English vowels and consonants by second language learners, or the errors existing in second language learners in the acquisition of English vowels. The experiments comparing native and non-native speakers' perception of English phonetics (taking vowels as an example) and related literature on Chinese students' pronunciation accuracy of tense and lax vowels in English are relatively scarce. Therefore, this paper first compares the auditory perception of English corresponding tense and lax vowels between native and non-native speakers through auditory experiments, and then explores the accuracy of English pronunciation of Chinese English majors and non-English majors through literature and experimental review. The paper also analyzes which one of the two methods for Chinese English learners to perceive vowels is more feasible, namely the method of forming the same or similar vowel phonemic categories as native English speakers on the basis of experience perception, and the method of distinguishing corresponding tense and lax vowels through duration [1]. This paper will provide some reference for Chinese English phonetics teaching and second language learners' English vowel perception and pronunciation.

2 Methodology

This paper conducted a comparative study on the auditory perception of English tense and lax vowels in ten native speakers and non-native speakers (including five native speakers and five non-native speakers), taking /i:-i/, /u:-ʊ/, /a:-e/, and /ɔ:-ɔ/ as examples.

2.1 The Selection of Listening Materials

Vocabulary recordings used in this auditory experiment were all from the Collins Electronic Dictionary, and were read by standard British speakers. A total of 40 words were included in the experiment, which were divided into four groups according to four different types of corresponding tense and lax vowels. There are ten words in each group, including five words with tense vowels and five words with lax vowels. In order to increase the objectivity of the vowel recognition, all words were recorded randomly after being sorted by Excel.

2.2 Participants Selection

A total of 12 subjects participated in this experimental study, including 6 native English-speaking subjects and 6 non-native English-speaking subjects. Out of the 6 native language subjects, 4 of them are from the United Kingdom, 1 from New Zealand, and 1 from the United States. The 6 non-native speakers are all college students majoring in English and non-English majors from Tan Kah Kee College, Xiamen University, Fujian Province, with 3 English majors and 3 non-English majors respectively. All subjects master the English vowel symbols and are able to use them proficiently. All non-native speakers have no experience living or studying in an English-speaking area. All subjects have normal hearing.

Table 1. Phonetic symbol reference.

IPA	[i:]	[i]	[u:]	[ʊ]	[a:]	[e]	[ɔ:]	[ɒ]
K.K.	**[i]1**	[ɪ]	[u]	[ʊ]	[a]	[ɛ]	[ɔ]	[a]
D.J.	[i:]	[i]	[u:]	**[u]1**	[a:]	[e]	[ɔ:]	**[ɔ]1**

Table 2. Comparison of total data between native and non-native speakers in the corresponding tense and lax vowel experiment.

Group	Average accuracy	Standard deviation
Native participants	37.667	1.886
Non-native participants	29.667	4.784

2.3 Experimental Process

The experiments were carried out in a quiet and noise-free environment. After the experimental rules were explained to all subjects, the recorded video was played using a fully functioning electronic device. All participants will answer on the designed answer sheet. In order to avoid the influence of different English phonetic systems learned by all participants, the IPA, K.K. and D.J. phonetic systems of the same sound will be listed on the answer sheet for reference (shown in Table 1).

In order to prevent participants from being misled by word stress, the four groups of corresponding tense and lax vowel phonetic symbols included in this auditory experiment are listed after each question number. While listening to the recording, the participants select the first corresponding tense or lax vowel phonetic symbol for each word they hear. For example, when they hear jewelry /'dʒu:əlrɪ/, they need to choose /u:/ or [ʊ] according to the English phonetic symbol they have learned. Since the same symbol in different phonetic systems expresses different pronunciations, it is stipulated here that the DJ phonetic symbol [u] expressing [ʊ] in IPA is marked as [u]1 in this experiment to distinguish the KK system of [u:] in the IPA system [u]; Similarly, the DJ phonetic symbol [ɔ] expressing [ɒ] in the IPA system is marked as [ɔ]1 to distinguish the KK system [ɔ] expressing [ɔ:] in the IPA system; The KK phonetic symbol [i] expressing [i:] in the IPA system is marked as [i]1 to distinguish the IPA and DJ phonetic symbols [i] expressing [i] in the IPA phonetic symbol. Each word will be played only once. The experiment will last about ten minutes.

3 Results

All the experimental data were collected and sorted according to the following two comparison objectives: the native speaker group and non-native speaker group, and the English major student group and non-English major student group.

It can be seen from Table 2 that there is a large difference in the correct rate of the native and non-native subjects in the elastic vowel experiment. The standard deviation

Table 3. Comparison between English majors and non-English majors in the non-native group in each group's corresponding tense and lax vowel experiments.

	/i:-i/			/u:-ʊ/		
Group	Average accuracy	Standard deviation	Accuracy	Average accuracy	Standard deviation	Accuracy
English major participants	4.5	0.5	45%	4	0.577	40%
Non-English major participants	2.333	0.745	23.3%	2.167	0.687	21.7%
	/a:-e/			/ɔ:-ɔ/		
Group	Average Accuracy	Standard Deviation	Accuracy	Average Accuracy	Standard Deviation	Accuracy
English major participants	4	1	40%	4.333	0.745	43%
Non-English major participants	1.833	0.687	18.3%	2.167	1.067	21.7%

value of the native language test group is small, the difference is not obvious, and the difference in the correct rate within the group is small; the non-native language test group has a lower correct rate and a large standard deviation value, the difference is more obvious, and the difference in the correct rate within the group is large. The correct rate of the native-speaking group was much higher than that of the non-native-speaking group.

It can be seen from Table 3 that the ability of the English majors in the auditory perception of corresponding tense and lax vowels is significantly higher than that of the non-English majors. The difference in the accuracy of the two groups is large, and the accuracy of each group differs by about 20%. In the /a:-e/ group, the correct rate of the English majors is nearly 35% higher than that of the non-English majors, and the difference is the largest. In addition, in the remaining three groups of corresponding tense and lax vowel auditory experiments, the English majors and the non-English majors show similar results. The difference between the correct rates in the English majors is small, the correct rate is higher; the correct rate of the non-English major participants varies greatly, and the correct rate is significantly lower than that of the English major participant group. In addition, from the test group of English majors, there is little difference among the four groups of the corresponding tense and lax vowel auditory experiments, all of which are 40% and above; From the test group of non-English majors, the correct rate is significantly lower than the other three groups in the /a:-e/ group, only 18.3%. Other than that, the correct rate of the other three groups is not much different, all above 20%.

4 Analysis

From the results of the auditory experiment, it is not difficult to find that Chinese English learners have a weaker perception of the corresponding tense and lax vowels. After consulting the related literature, the reasons are summarized as follows.

4.1 Negative Transfer Effect of Mother Tongue (Chinese)

The main reason for the problems of Chinese students in the pronunciation of English tense and lax vowels is that they are influenced by their mother tongue in the process of acquiring English pronunciation, known as the phenomenon of negative transfer of mother tongue. When learning a second language, one will be affected by the transfer of his or her native language habits. There are both positive transfer that promotes the learning and negative transfer that interferes and hinders the learning. They are collectively referred to as the "native language transfer" [2]. Chinese and English vowels are two completely different systems. There is no tense and lax vowel in Chinese vowel system, but there are corresponding tense and lax vowels in English, and there are obvious differences in pronunciation duration. In this point, the negative transfer phenomenon of mother tongue is apparent.

There are ten vowels in Chinese: /a/, /o/, /e/, /i/, /ê/, /u/, /ü/, /-i/, /-i/, /er/; and English vowels are roughly divided into tense vowels, lax vowels, monophthong, and diphthongs (they are roughly recorded as monophthong and diphthongs for convenience here). There are monophthong [iː], [i], [ɔː], [ɔ], [uː], [u], [əː], [ə], [ɑː], [ʌ], [e], [æ], and diphthongs [ei], [ai], [ɔi], [ɛə], [uə], [iə], [au], [əu], a total of 20. It can be seen that the vowels in Chinese are much less than those in English, and Chinese vowels are not divided into tense or lax vowels. This increases the difficulty for Chinese English learners to perceive the corresponding tense and lax vowels in English. In addition, the pronunciation of some Chinese vowels is similar to that of English vowels. For example, the pronunciation of "wu" in Chinese "raven" is similar to "hook" (/hʊk/) and "through" (/θruː/); The "yi" in Chinese "clothes" is pronounced similarly to "sheep" (/ʃiːp/) and "lift" (/lɪft/). Influenced by Chinese pronunciation, many Chinese English learners will assimilate Chinese pronunciation with English pronunciation, which further confuses the difference between tense and lax vowels. Therefore, we can conclude that the unclear differentiation of vowels may lead to the deviation in the understanding of word meaning, and then communication obstacles; additionally, for second language learners, the output of the second language is based on the input. If the input has been indistinguishable, it will inevitably have a certain impact on the second language output.

4.2 Misunderstanding of Long and Short Vowels

As we all know, Chinese English teaching has always respected the DJ system. In the DJ system, there are four pairs of corresponding tense and lax vowels, namely: /iː/-/i/, /ɔ/-/ɔː/, /u/-/uː/, and /ə/-/əː/. The phonetic shape of each pair of corresponding tense and lax vowels is the same, and the only difference is the presence or absence of the length symbol [ː]. This is a trap for English beginners. Long vowels are not a simple extension of short vowels. Their difference is not only in length, but also in pronunciation. There are

two differences in "sound quantity" and "sound quality" [4]. Chinese second language learners usually distinguish tense and lax vowels by the length of vowels. Since the speech rate is faster and there are fewer pauses in real communication, there is almost no time for non-native speakers to react, think, and judge. The method of distinguishing tense and lax vowels by length does not work.

Chen [4] believed that the length of vowels is relative, and long vowels are not always longer than short vowels. In the process of studying English phonetics, someone used an instrument to measure the length of vowels when British people read the words "seat", "seating", and "hid". It is found that the long vowel /i:/ was pronounced in "seat" for 0.123 s and "seating" for 0.087 s, while the short vowel /i/ was pronounced 0.149 s in "hid". That is to say in these words, the long vowel /i:/ is shorter than the short vowel /i/ (Gimson). Whether long vowels or short vowels, their length is not absolutely constant. The so-called length, of course, is relative. The speed of speech is different, and the vowel length is also different accordingly. According to statistics, the average rates of speech in British and Americans range from 6 to 20 phonemes per second (Gimson) [5]. Therefore, it is not feasible to distinguish vowels by the length of vowel pronunciation alone. As we all know, China has always adopted the DJ system as the English transcription system, and the status of the DJ system in Chinese English phonetic teaching is evident. Almost every set of English textbooks published in China contains quite a few long and short vowel contrast exercises, such as:

/sit-si:t/ /fɔ:t-fɔg/

/bid-bi:t/ /bɔ;t-bɔks/

/giv-gi:s/ /lɔ:d-lɔt/

The length of vowels is important, but when designing pronunciation exercises, the difference in "sound quality" of tense and lax vowels and the comparison of length changes should also be highlighted. If we ignore the regularity of vowel length variation, blindly emphasize the length contrast, and, in any case, pronounce the long vowel longer than the short vowel, students will be led astray [4].

Some scholars have studied the pronunciation of Chinese English majors and non-English majors in the selected corpus (with /i:/-/i/, /ɔ/-/ɔ:/, /u/-/ u:/, /ə/-/ə:/ for example). They compared the pronunciation duration to verify whether the participants pronounced correctly. The results showed that the accuracy of participants pronounced the corresponding tense and lax vowels /i:/-/i/, /u/-/u:/, /ɔ/-/ɔ:/, and /ə/-/ə:/ is only 10%, 30%, 50%, and 20%, respectively. The problems of the participants in distinguishing the corresponding tense and lax vowels reflected in this auditory experiment are basically consistent with the conclusions drawn by previous researchers. In other words, Chinese students are difficult to distinguish English corresponding tense and lax vowels in terms of pronunciation length. It is not difficult to find that Chinese English learners cannot effectively distinguish between the corresponding tense and lax vowels in terms of sound quality, and many of them are also difficult to distinguish them in terms of pronunciation length due to the lack of long and short vowels in Chinese [3]. At the same time, combined with the above auditory experiments, it can also be concluded that English majors perform better than non-English majors in the perception and pronunciation of corresponding tense and lax vowels. It also proves to a certain extent that the systematic

training on English listening and pronunciation English majors receive during the period plays a certain role.

5 Conclusion

From the corresponding English vowel auditory experiment results, it can be concluded that the accuracy of native participants is much higher than that of non-native participants, and the accuracy of English majors is higher than that of non-English majors. The reasons can be summarized as follows: firstly, due to the negative transfer of Chinese, Chinese English learners confuse some English vowels with similar pronunciations in Chinese, and have certain difficulties in perceiving the corresponding English vowels. Secondly, influenced by the difference between Chinese and English vowel systems and the DJ system that is respected in Chinese English teaching, most Chinese English learners have more difficulty in perceiving English vowels. They distinguish tense and lax vowels by the length of vowel pronunciation. However, the method is not feasible and the difficulties in the process of perceiving vowels will lead to deviations in the comprehension of word meanings, which will lead to certain obstacles to communication; in addition, the experimental results of English-major participants and non-English major participants have a relatively huge difference, which shows that the systematic training of listening and pronunciation (taking vowels as an example) for English majors is helpful to the perception of corresponding English vowels to a certain extent.

Due to the impact of the COVID-19 pandemic, it is impossible to leave for English-speaking countries to conduct experiments in person. The auditory experiments included in this paper were successfully completed with the help of enthusiastic Chinese students from Imperial College London. In addition, the relevant data of the auditory experiment in this paper is relatively few. Influenced by the unstable domestic pandemic situation, most Chinese colleges and universities have implemented online teaching courses. It is impossible to contact a large number of English majors or non-English majors to participate in the experiment, and the experiment can only be conducted online due to the epidemic. Therefore, the experimental data are affected to a certain extent. Furthermore, the relevant recordings of the auditory experiment in this paper are all standard British pronunciations, which do not take into account the influence of different regions of the native speaker on accent changes. For instance, /ʊ/ in “foot” /fʊt/ and /u:/ in “goose” /gu:s/ are pronounced as /ʊ/ by many native Scottish and Northern Irish speakers.

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